PHD/IEG-28/72
11 February 1972

25X1 MEMORANDUM FOR: [redacted]

SUBJECT : Radio Horizon Prediction

The objective of this project was to determine a visual line of sight from a U-2 aircraft flying at 70,000 feet, to a point which is approximately located at 42° 17' 15"N and 126° 54' 00"E, with elevation of 3,120 feet.

The initial problem was to find a map that contained a reliable vertical accuracy. There are only two series of large scale maps that have been published. The 1501 AIR 1/250,000 scale and a WAC 1/200,000 scale. The 1501 AIR Series, 1/250,000 scale maps appear to contain the best accuracy of both the contours and vertical elevations.

The technique used to compute a visual line of sight is as follows:

(1) The ONC series, 1/1,000,000 scale maps (F-9 and G-10) were used as the base maps. The limits of the line of sight were determined by

25X1 [redacted] This area was determined to be 40 degrees as you swing an arc from point 3120.

(2) On the ONC, the 40 degrees were then broken down into one degree segments. Lines were drawn every one degree that radiate from point 3120.

(3) The same 40 degree arc was then determined on the 1501 AIR series, 1/250,000 scale maps, (NK 52-7 and KN 52-4) and broken down into one degree segments. Lines were then drawn every one degree that also radiate from point 3120. Each of the one degree lines cover the same path on both maps. For simplicity the lines are numbered from east to west.

(4) It was then determined that the only elevations that would obstruct a line of sight would be within the first 50 nautical miles of point 3120. Therefore all of the obstructions would be on the 1501 AIR series 1/250,000 scale maps. Elevations were interpolated from the contours, and distances were measured from the elevations to point 3120.

(5) A formula was then derived to correct for earth curvature and air refraction. The formula is

$$d = \frac{k}{2} + \sqrt{\frac{k^2}{4} + C_1 (h_2 - h_1)}$$

where

$$k = \left[ d_1 - c_1 \left( \frac{h - h_1}{d_1} \right) \right]$$

$C_1$ = 1.316 because heights are in feet and distances are in nautical miles
$d_1$ = distance from 3120 to obstruction
$h_1$ = height of 3120
$h_1'$ = height of obstruction
$h_2$ = height of aircraft
$d$ = distance from 3120 to aircraft that will give a visible line of sight

(6) Distances were calculated using the above formula for each line and were plotted on the ONC 1/1,000,000 scale map. A line of sight was plotted for a flight height of 70,000 feet [redacted] These lines vary approximately 10.9 nautical miles. If a 65,000 foot flight height were to be plotted it would be approximately 11.3 nautical miles from the 70,000 foot flight in the direction of point 3120. 25X1

It should be noted that the elevations that were interpolated from the 1/250,000 scale map do contain some error. If for example the interpolated elevation is 50 feet in error, the distance of the visible line of sight would be about 2.1 nautical miles in error.

An estimated accuracy for the position of the visible line of sight would be plus or minus 6.3 nautical miles. 25X1

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Chief, Aerospace Section
MB/PHD/IEG/NPIC
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Attachments